

F i s h e r i e s I m p r o v e m e n t C o m m i t t e e

By B.I. DYBERN

1968

Reports on work done have only been received from some countries. Ireland reports that there is very little work in the field of the Committee.

Belgium

(E. Leloup)

Improvement

Etude des conditions biologiques actuelles d'une zone côtière en vue de l'installation d'un égoût.

Prévisions 1969

Poursuite des recherches entreprises en 1968.

Canada

(R.W. Trites)

The activities reported are based on work undertaken by three Federal Agencies: Fisheries Research Board, Department of Fisheries, and the Department of Energy, Mines and Resources.

Pollution

Studies on biological indicators of mine pollution (Cu and Zn) were carried out in the NW Miramichi River area of northern New Brunswick. Herbaceous Dicotyledons were almost completely absent from banks of polluted stretches. Monocotyledons and Equisetum were not apparently affected by levels of pollution encountered. Benthic plant communities, formed by algae, differed quite markedly according to the various degrees of mine pollution encountered. Quantitative bottom samples of invertebrates are being evaluated. Hydropsyche (caddisflies) dominated in some of the more polluted parts and Tubellaria were virtually absent. In unpolluted areas of the same stream, the most abundant Tubellaria were Cura foremanni and Dugesia tigrina.

A small, controlled field experiment with NTA (nitrilotriacetic acid) to reduce deleterious effects of Cu and Zn pollution yielded promising results. In a stream, artificially polluted by Zn and Cu sulfates, NTA protected both natural aquatic invertebrates and caged fish from copper and zinc poisoning. During a 2 month laboratory test, small salmon lived and grew as well as controls when held in NTA itself, and in strong (40 toxic units) zinc-copper concentration, plus NTA; nor did these experimental conditions cause any histopathology beyond that found in controls. In laboratory tests, NTA dampened the avoidance reaction of salmon to zinc by a ten-times factor.

Toxicity of several insecticides to salmon has been tested. For two of the more important, Phosphamidon and Sumithion, lethal thresholds were at 1 mg/l.

Preliminary surveys of the Miramichi River estuary showed a high degree of organic pollution. The organic compounds have been isolated from the effluent and separated into four fractions. Of these, the neutral fraction contains mainly aliphatic, aromatic, and a small amount of polynuclear hydrocarbons. The acidic and residual fractions contain phenols; the basic fraction has not yet been analysed.

Following up previous work which showed that exposure of brook trout for 24 hours to sublethal DDT completely prevented learning of a conditioned avoidance response in a two-chambered choice box, trout were trained to exhibit



the propeller tail reflex. Exposure to sublethal DDT (20 ppb) prevented establishment of the simple conditioned reflex in the majority of fish. The number of trials required for the remainder was significantly in excess for those made for controlled fish. The work to date suggests that sublethal DDT affects learning ability of fish by acting upon central nervous structure.

The needs for quantitative information on flushing of estuaries and coastal embayments in order to predict the capacity of a particular area to accept pollutants and maintain effluent concentrations below specified levels, continue to increase. In 1968 a brief survey was carried out in the Pictou area of Nova Scotia complementing the work done earlier (1965) to determine flushing characteristics and predict distribution and concentration of effluent. The 1968 survey was carried out in order to determine the new flow patterns in the area, resulting from the construction of a causeway in Pictou Harbour and the elimination of tidal exchange in Boat Harbour.

#### Problems in Production of Seed Oysters

The supply of seed oysters has always been an important limitation on the realisation of the full potential of the oyster industry of eastern Canada. To the variable severe climate of the area has been added a general ecological deterioration of the key spawning areas in the creeks, resulting in only occasional natural recruitment in many areas.

The Experimental Shellfish Hatchery at Ellerslie, P.E.I. has played an important role in the investigation of the factors important in seed oyster production under controlled, hatchery conditions and in the field. In the past few years commercially applicable methods have been developed and shown to be biologically feasible in eastern Canada.

The programme has included investigation of techniques of mass culture of the flagellates used as food for larval molluscs. A pasteurization technique, rather than the normal autoclaving, has been shown to be satisfactory, and even advantageous, in preparing culture media. Several good species have been adapted, after several generations, to growth in natural sunlight, and a simple, water-cooled, culture apparatus developed. Such culture is now well within the competence of commercial hatchery operators. As an alternative to the doubtfully economic alternatives now available, this has great commercial promise for both hatchery and natural production.

#### Resource Development Branch of the Department of Fisheries of Canada

This is an applied science organisation employing biologists, engineers, technicians, fish culturists and other staff in a wide variety of tasks related to protecting, managing and expanding some of Canada's most valuable fish and shellfish resources. In the Atlantic Provinces of Canada (New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland) the overall aim of the Branch is to protect and, where economically feasible, expand opportunities for fishing. The responsibilities of the Resource Development Branch, therefore, closely parallels the interest of the Fisheries Improvement Committee. Some examples of projects carried out by the Branch are:-

##### 1. Mactaquac Atlantic Salmon Smolt Station, New Brunswick

An important commercial and sport fishery is threatened by the Mactaquac Hydroelectric Power Dam on the Saint John River in New Brunswick. Maintenance of the Saint John River Atlantic salmon run has depended on successful spawning of adult fish in the headwaters. Future production of smolts from these headwaters is unlikely due to high turbine mortalities at three successive hydroelectric dams located in the path of the seaward migrating smolts. An additional problem is the creation of a sixty-mile-long reservoir above the Mactaquac Dam which may result in increased predation and a delay in seaward migration. To overcome these difficulties, the largest Atlantic salmon smolt rearing station in the world has been constructed below the dam. A smolt production of 500,000 per year is required to replace the natural production lost above the dam. Selective breeding and smolt tagging is being conducted and a total assessment will be made to evaluate the effectiveness of hatchery smolt production in maintaining the fishery.



2. Saint John River Pollution Abatement, New Brunswick

Gross pollution from sulphite pulp and paper mills and the danger of proposed sulphate pulp mills endanger the fish producing capacity of this important salmon river in New Brunswick. Additional pollution from food processing plants, agricultural sprays and domestic sewage worsens this dangerous situation. An extensive programme of detection and monitoring has been initiated by the Resource Development Branch to assess the extent and nature of the pollutants. New techniques are being explored to find ways to reduce toxicity and B.O.D. from pulp-mill effluents.

3. Salmon Rehabilitation on the East River, Nova Scotia

A rehabilitation programme is underway to re-establish runs of Atlantic salmon eliminated by hydroelectric power installations in this Nova Scotian river. Seaward migrating Atlantic Salmon smolts, the progeny of adult salmon transferred to the river from a nearby stream, are diverted from the power canal to the main river below the power dam so as to eliminate turbine mortalities. A lower fish guiding system is the main feature of the diversion system. Early results indicate that 90 per cent of the downstream migrating smolts can be successfully diverted. Data on the behaviour of spawning salmon, freshwater mortalities and the dynamics of stream production are being gathered.

4. Atlantic Salmon Spawning Channel, Newfoundland

The first controlled flow spawning channel for Atlantic salmon was built on Indian River, Newfoundland in 1963 to replace several miles of natural spawning grounds lost to hydroelectric power development. Extensive evaluation techniques are underway to determine the effectiveness of the spawning channel in maintaining Atlantic salmon populations. Information on egg to fry survival, spawning behaviour, sex ratios and early life history studies are available. A second spawning channel has been constructed on the Exploits River upstream of an obstruction which blocks approximately 80 per cent of the river for potential salmon production. The spawning channel is an attempt to provide ideal spawning environment so as to increase the size of the spawning run to populate the upstream areas.

5. Oyster Farming Experiments on Prince Edward Island

Preliminary results indicate that the bottom management technique of planting broken scallop shell is useful in eastern Canada. A two to thirteen-fold increase in spat settlement was achieved. The world's first mobile oyster hatchery is testing potential sites for commercial hatchery location. As a result of work in 1968, a privately-owned commercial unit has now been constructed on one site which was tested.

Denmark

(O. Bagge)

Oxygen consumption as a function of feeding level and body size has been studied on Tilapia in aquaria.

The speed of digestion in relation to temperature has been studied on cod and the common sea scorpion in aquaria.

Finland

(A. Voipio)

Finland has started bilateral investigations on the pollution conditions in the Gulf of Finland with the Soviet scientists.



Germany  
(A. Kotthaus)

'Biologische Anstalt Helgoland'

Culture experiments with different North Sea fish, especially sole and turbot, have been continued.

The adaptability of rainbow trout to different salinities has been investigated (together with the 'Institut für Hydrobiologie und Fischereiwissenschaften der Universität Hamburg' and the 'Institut für Küsten- und Binnenfischerei').

In 1968 the investigations on the splitting up of oil by microbes were continued. Large scale tests on the propagation of oil-splitting microbes were carried out in basins holding 100 litres of sea-water, with addition of oil agglutinants and inorganic nutritive salts. The toxicity of different emulgative substances to natural populations of marine microbes, enriched oil splitting bacteriae in the sea, and bacillicultures were tested. Investigations on the occurrence and distribution of oil-splitting bacteriae in the sea and in litoral sediments, polluted by oil, were also carried out.

The influence of sulphuric-acid waste waters of a titan producing plant on planktonic flagellates was tested, especially with regard to their propagation.

Special investigations were carried out on the present biological status of the prospective dumping ground for sulphuric-acid wastes of a titan producing factory.

'Deutsches Hydrographisches Institut'

A new device has been developed for the registration of acid wastes in the sea. The pH-values of the water near to the bottom is continuously recorded down to a maximum depth of 50 metres.

In 1969 investigations on the chemical changes in the sea brought about by sulphuric acid wastes will be started.

'Institut für Küsten- und Binnenfischerei'

The toxicity of detergents in relation to the salinity of sea-water was studied by investigations on eels and several crustacean species. It was found that the toxicity is increasing with increasing salinity of the water.

Netherlands  
(P. Korringa)

Within the Ministry of Waterworks research was carried out on disposal of waste into the sea and estuaries by ship and by pipe-line.

The studies of estuaries were mainly concerned with oxygen content, whereas the studies in the sea were mainly on mixing and diffusing processes.

Incidental measurements and counts were carried out by other institutes on nitrite, nitrate, zinc, phosphate, productivity and phytoplankton.

Within the framework of the International Committee for the Protection of the Rhine against Pollution, a great number of data was obtained on oxygen, chloride, sulphate, phenol, radio-activity, BOD, iron, pH, ammonia and phosphate of this river, which has such a great influence on the quality of the coastal sea-water.

A number of institutes made more or less regular observations of the salinity of the coastal sea-water.

In the Fisheries Laboratory a classical analytical method was worked out on the chemical determination of traces of organic mercury in fish.



Norway  
(F. Beyer)

'Fiskeridirektoratets Havforskningsinstitutt' (Kr.Fr. Wiborg, B. Høhle), Bergen, in co-operation with 'Statens Biologiske Stasjon' (G. Dannevig), Flødevigen, have continued their experiments with cultivation of blue mussels (Mytilus edulis) on synthetic fibre ropes suspended from rafts of moderate size in various localities along the coast between Oslo and Bergen.

Mapping of natural stocks of Iceland scallop (Chlamys islandicus) in the Bear Island region was undertaken by Wiborg.

At the 'Institutt for Marin Biologi', University of Oslo, a Master's Thesis on the hydrography and chemistry in a heavily polluted basin in the Oslo Fjord was completed (A.T. Andersen). In connection with that another Master's Thesis was completed, dealing with variations with depth and time in the zooplankton and macrobenthos in the same area. Special attention was paid to the limiting effects of the pollution (B. Braaten).

Studies of the dispersion of pollutants and water exchange in various parts of the Oslo Fjord area and on the south coast of Norway were conducted by the 'Norsk Institutt for Vannforskning (NIVA)', Oslo.

Total  $\beta$  -radioactivity was measured in fish from Skagerrak, the western and northern coast of Norway, and the Barents Sea by the 'Fiskeridirektoratets Havforskningsinstitutt', Bergen. According to these measurements, the radioactivity in the fish was on an average only about 7% greater than the natural activity, which is due to potassium-40.

A survey of the sources and problems of pollution in Norwegian coastal waters was presented in the report of the Committee's Working Group on Pollution of the North Sea.

Sweden  
(B.I. Dybern)

Several institutes and laboratories are now concerned with coastal and open sea pollution problems. Some of the most important investigations are listed here.

Baltic Sea. Investigations on the oxygen deficit problem and the influence of low oxygen values on fish. Investigations on the content and circulation of P and N.

Idefjorden - Koster area (northern west coast). A hydrographical, biological and bacteriological survey of the influence of heavy pollution by sewage and sulphite pulp wastes on marine organisms, especially fish.

Stenungsund area (north of Göteborg). Influence of waste waters from refineries and related industries on bottom fauna and fish. Experimental investigations on the toxicity of monoethylene glycol, nonyl phenol and two surface active substances, non-ionic nonyl phenol ethoxylated with ten molecules ethylene oxide, and anionic sulfonate to cod and Lebistes.

Skerry belt off Göteborg. Hydrographical, chemical, bacteriological and biological investigations on the influence of the untreated sewage and waste water from the city of Göteborg, in connection with discussions of the future treatment of the wastes.

Kungsbacka Fjord (south of Göteborg). Hydrographical and biological investigations in the bay, considered as moderately polluted.

Øresund. In this area a joint Swedish-Danish survey of the influence by sewage and industrial waste waters on the marine life and fisheries has been carried out during a long period. During 1968 an investigation was made from the Swedish side on the eventual damages from sand-sucking operations, removing the surface layer of the bottom and revealing oxygen-poor or -free underlying sediments.

Wästervik area (central part of the Baltic coast). Hydrographical and biological investigations on stagnation problems and the additive effect of sewage pollution.



Stockholm area. A survey of the influence of different pollutants on marine life and fisheries, partly in connection with the so-called Lake Mälars Survey (fresh water, inside Stockholm).

Gävle Bight (north of Stockholm, southernmost part of the Bothnian Sea). Influence of certain industrial wastes (paper-pulp mills, metallurgic industries) on the hydrography and bottom life.

Several investigations along the Swedish coasts are devoted to the future influence of warm water from atomic power stations on the hydrographical conditions and the fishery.

Toxic substances. Marine organisms, especially fish, from different parts of the coastal waters and the open sea are examined for their content of mercury, DDT and PCB groups and other toxic substances. Some coastal waters are "black listed", that is fish caught there may be eaten by man on his own risk, but must not be sold on the market or given as gifts to other persons. The content of DDT and PCB is alarming in some fish and fish-eating birds and seals from the Baltic. As a rule, the content of these substances is considerably higher in fish from the Baltic as compared with those from the Swedish west coast.

#### United Kingdom

##### Scotland

(J.H. Fraser)

The work in 1968 followed the same general lines as before in 1) studies of the ecology of young flatfish in a sea loch, 2) sampling of the White Fish Authority's fish rearing experiments at Ardtoe, 3) the culture of mussels and 4) pollution studies.

#### Ecology of young flatfish

Among the physical factors examined, particular attention has been paid to the movement of sand both on the beach and subtidally, since this affects the distribution of animals on which the fish feed.

Estimates of the density and biomass of benthic animals were made in spring and autumn, and from these the available fish food - siphons of bivalves, palps of certain polychaetes, as well as whole polychaetes and crustaceans, has been calculated.

Between spring (when the young fish take to the bottom) and autumn, a number of surveys of 0-group plaice and dabs were carried out, and from these it was possible to obtain values for growth and mortality of the populations. Stomach analyses of fish from these surveys indicated the feeding rate, the preferences for each type of prey, and the changes which took place throughout the year.

Other aspects investigated include bottom plankton, for which a new sampler has been devised, and epifauna which comprise plaice predators as well as competitors.

This field work was combined with various experimental studies both on fish food (to find how it was affected by its own food supply and by predation) and on the young fish themselves (to find how the growth-rate and conversion efficiency was affected by external factors).

All these data are at present being integrated to provide a picture of the young fish stock and its food supply.

#### Experimental work at Ardtoe

During the year the Marine Laboratory continued to monitor the changes (in both substratum and fauna) which took place in the White Fish Authority pond at Ardtoe.

Colonisation of the pond appears to be slow but progressive and to be largely marine in character. There is a basic population composed of a few species - polychaete worms (capitellids, spionids mainly Scololepis fuliginosa, Nereis diversicolor, Arenicola marina), oligochaetes and chironomid larvae, accompanied by a varying number of other species of phyllodocids, spionids, amphipods, and nemertines.



The occasional short-term draining of the pond, necessary for one reason or other, produces a set-back in the development of the benthos, but the recovery period is surprisingly short.

A marked drop in benthos at one part of the year appeared to be associated with predation by the large flatfish population and the removal of a considerable proportion of these fish to floating tanks will provide a useful opportunity to compare the benthic fauna in two situations: with and without predators.

#### Cultivation of mussels

Experiments on the rope cultivation of mussels have been continued in two areas of differing potential off the west of Scotland. In the more promising area mussel growth was such as to permit harvesting for commercial use only eighteen months after settlement.

Hydrobiological surveys are being continued to obtain data on inshore water movements so as to study changes or possible changes due to pollution, and to be able to give advice as necessary concerning industrial development.

#### Pollution

An outbreak of paralytic shellfish poisoning off the NE coast of England and SE coast of Scotland in the summer of 1968, which led to the death of fish and birds and resulted in poisoning to man, was monitored by toxicity tests on mussels and scallops. This work was carried out in co-operation with Universities and with the English laboratories.

(A.V. Holden)

#### Pesticides in the marine environment

During the year a number of salmon, taken on the West Greenland coast in 1967, were examined for organochlorine residues. Dieldrin and the three members of the DDT group (DDE, TDE and DDT) were detectable at low levels in all muscle and liver samples, the amounts in liver being only slightly higher than in muscle. The DDE component was dominant in all samples, the total of DDT-group residues having a mean of 0.041 p.p.m. in muscle and 0.057 p.p.m. in liver. Dieldrin concentrations were lower than those of the three DDT-group residues. The variation between individuals was small for all residues.

Other marine species from which muscle and liver samples have been examined include cod, haddock and whiting (all taken off Orkney and Shetland) and in all cases the concentrations of dieldrin and DDT-group residues were much higher in the liver. DDE was again the major residue with smaller amounts of TDE and DDT, and only traces of dieldrin. Sprats have also been sampled from Scottish coastal waters and found to contain DDT-group residues together with a number of other chlorinated substances. Mussels from Scottish coastal sites have been analysed as part of an OECD programme of residue studies, and dogfish samples are also included in this programme.

A few blubber samples from marine mammals have been examined, using a new and more rapid clean-up technique. Appreciable concentrations of chlorinated residues were found, as in similar samples analysed previously. DDE was detected in the fat of an Antarctic penguin, Aptenodytes forsteri, as well as significant amounts of other, as yet unidentified, electron-capturing substances. Samples of seal blubber have been received for examination, from Canada, Norway, Sweden, Holland, Scotland and England.

#### U.S.S.R.

(S.G. Fedorov)

In 1968 the research on the adaptation of Pacific salmon, genus Onchorhynchus, and the king crab to the environment in the White Sea and Barents Sea basins was continued.

The number of migrants belonging to the second generation of the local population produced in the Murman rivers was in 1968 higher than the average of the period 1961-1967. The same type of fishing gear was used all years.

5 million fingerlings, hatched from eggs brought in from Kamchatka and Sakhalin during the autumn of 1967 were released in 1968 into the Onega River (Archangel Region, White Sea). These young salmon migrated seaward in shallow channels in the river banks. Timber-floating, high water and other unsatisfactory conditions impeded their progress considerably. The number of grown-up migrants recorded in catches was small: 5 pink salmon, 1 chum and 1 sockeye.

810 king crabs have been released into inlets along the Murman coast. During an investigation in August, 1968 they could not be recovered by skin-divers.

Recaptures of young specimens of Acipenseridae, released during previous years, were made in the Baltic Sea.

In 1969 investigations of the downstream migration of Far East salmon fry and of the conditions of the regions where king crabs are released will be carried out.